Claims:

1. A method of reducing sludge formation during electroplating of copper over a substrate, comprising:

applying a current between a consumable anode comprising copper and the substrate so that the consumable anode is at a potential of greater or equal to about 2.2 V in reference to the normal hydrogen scale.

2. The method of claim 1, wherein the applying a current comprises providing a current density to the substrate between about 5 mA/cm^2 and about 600 mA/cm^2.

3. The method of claim 2, wherein the current density to the substrate is between about 10 mA/cm^2 and about 60 mA/cm^2.

4. The method of claim 1, wherein the consumable anode has an exposed surface area to an electrolyte solution less than an exposed surface area of the substrate to the electrolyte solution.

5. The method of claim 1, wherein the consumable anode has an exposed surface area to an electrolyte solution less than or equal to one-half of an exposed surface area of the substrate to the electrolyte solution.

6. The method of claim 4, wherein the consumable anode has a diameter substantially equal to a diameter of the substrate.

7. The method of claim 4, wherein the consumable anode has a diameter less than a diameter of the substrate.

8. The method of claim 4, wherein the consumable anode has holes formed therethrough, the method further comprising flowing the electrolyte solution through the holes of the consumable anode.

9. The method of claim 1, wherein the applying a current comprises maintaining

the consumable anode at the potential of greater or equal to about 2.2 V in reference to the normal hydrogen scale for a time period of about 50% or more of a time period for electroplating of the substrate.

10. The method of claim 1, wherein the applying a current comprises maintaining the consumable anode at the potential of greater or equal to about 2.2 V in reference to the normal hydrogen scale during substantially an entire period of electroplating of the substrate.

11. The method of claim 1, wherein the applying a current comprises monitoring the consumable anode with a reference electrode and adjusting the current between the consumable anode and the substrate.

12. The method of claim 1, wherein the applying a current comprises determining a relationship of an applied current between the consumable anode and the substrate under the potential of greater than or equal to about 2.2 V to the consumable anode and adjusting the current based upon the relationship.

13. A method of reducing sludge formation during electroplating of copper over a substrate, comprising:

applying a current between a consumable anode comprising copper and the substrate so that the consumable anode is at a potential of greater or equal to about 3.7 V in reference to the normal hydrogen scale.

14. The method of claim 13, wherein the applying a current comprises providing a current density to the substrate between about 5 mA/cm^2 and about 600 mA/cm^2.

15. The method of claim 14, wherein the current density to the substrate is between about 10 mA/cm^2 and about 60 mA/cm^2.

16. The method of claim 13, wherein the consumable anode has an exposed surface area to an electrolyte solution less than an exposed surface area of the substrate to the electrolyte solution.

17. The method of claim 13, wherein the consumable anode has an exposed surface area of to an electrolyte solution less than or equal to one-half of an exposed surface area of the substrate to the electrolyte solution.

18. The method of claim 16, wherein the consumable anode has a diameter substantially equal to a diameter of the substrate.

19. The method of claim 16, wherein the consumable anode has a diameter less than a diameter of the substrate.

20. The method of claim 16, wherein the consumable anode has holes formed therethrough, the method further comprising flowing the electrolyte solution through the holes of the consumable anode.

21. The method of claim 13, wherein the applying a current comprises maintaining the consumable anode at the potential of greater or equal to about 3.7 V in reference to the normal hydrogen scale for a time period of about 50% or more of a time period for electroplating of the substrate.

22. The method of claim 13, wherein the applying a current comprises maintaining the consumable anode at the potential of greater or equal to about 3.7 V in reference to the normal hydrogen scale during substantially an entire period of electroplating of the substrate.

23. The method of claim 13, wherein the applying a current comprises monitoring the consumable anode with a reference electrode and adjusting the current between the consumable anode and the substrate.

24. The method of claim 13, wherein the applying a current comprises determining a relationship of an applied current between the consumable anode and the substrate under the potential of greater than or equal to about 3.7 V to the consumable anode and adjusting the current based upon the relationship.

25. A method of reducing sludge formation during electroplating of copper over a substrate, comprising:

providing a consumable anode comprising copper, wherein the consumable anode has an exposed surface area to an electrolyte solution less than an exposed surface area of the substrate to the electrolyte solution; and

applying a current between the consumable anode and the substrate so that the consumable anode is at a potential of greater or equal to about 0.9 V in reference to the normal hydrogen scale and so that a current density to the substrate is between about 10 mA/cm^2 and about 60 mA/cm^2.

26. The method of claim 25, wherein the applying a current comprises maintaining the consumable anode at the potential of greater or equal to about 0.9 V in reference to the normal hydrogen scale during substantially an entire period of electroplating of the substrate.

27. A method of reducing sludge formation during electroplating of copper over a substrate, comprising:

providing a consumable anode comprising copper, wherein the consumable anode has an exposed surface area to an electrolyte solution less than or equal to one-half of an exposed surface area of the substrate to the electrolyte solution; and

applying a current between the consumable anode and the substrate so that the consumable anode is at a potential of greater or equal to about 0.9 V in reference to the normal hydrogen scale.

28. The method of claim 27, wherein the consumable anode has a diameter substantially equal to a diameter of the substrate.

29. The method of claim 27, wherein the consumable anode has a diameter less than a diameter of the substrate.

30. The method of claim 27, wherein the consumable anode has holes formed therethrough, the method further comprising flowing the electrolyte solution through the

holes of the consumable anode.

31. A method of reducing sludge formation during electroplating of copper over a substrate, comprising:

providing a consumable anode comprising copper; and

applying a current between the consumable anode and the substrate so that the consumable anode is at a potential of greater or equal to about 0.9 V in reference to the normal hydrogen scale and so that a current density provided to the consumable anode is greater than or equal to 40 mA/cm^2.

32. The method of claim 31, wherein the current density to the consumable anode is greater than or equal to 90 mA/cm^2.

33. A method of reducing sludge formation during electroplating of copper over a substrate, comprising:

providing a current between the consumable anode comprising copper and tellurium and a substrate to electroplate copper from the consumable anode onto the substrate.

34. A method of electroplating a substrate utilizing a consumable anode assembly, comprising:

providing a reference electrode proximate the consumable anode assembly;

providing a current to the consumable anode assembly; and

measuring a potential applied to the consumable anode assembly with the reference electrode.

35. The method of claim 34, further comprising adjusting the current to the consumable anode based upon a measured potential by the reference electrode.

36. The method of claim 35, wherein the current is adjusted so that an adjusted potential applied to the consumable anode is greater or equal to about 0.9 V in reference to the normal hydrogen scale.

37. The method of claim 35, wherein the current is adjusted so that an adjusted potential applied to the consumable anode is greater or equal to about 2.2 V in reference to the normal hydrogen scale.

38. The method of claim 35, wherein the current is adjusted so that an adjusted potential applied to the consumable anode is greater or equal to about 3.7 V in reference to the normal hydrogen scale.

39. An electroplating apparatus, comprising:
an electroplating cell having a cavity;
a consumable anode comprising copper and disposed in the cavity;
a contract ring adapted to receive a substrate; and
a power source coupled to the consumable anode and the contact ring and adapted to provide a current between the consumable anode and the substrate so that the consumable anode is at a potential of greater or equal to about 2.2 V in reference to the normal hydrogen scale.

40. The apparatus of claim 39, wherein the power source is adapted to provide a current between the consumable anode and the substrate so that the consumable anode is at a potential of greater or equal to about 3.7 V in reference to the normal hydrogen scale.

41. The apparatus of claim 39, wherein the power source is adapted to provide a current density to the substrate between about 5 mA/cm^2 and about 600 mA/cm^2.

42. The apparatus of claim 39, wherein the power source is adapted to provide a current density to the substrate between about 10 mA/cm^2 and about 60 mA/cm^2.

43. The apparatus of claim 39, wherein the power source is adapted to provide a current density greater than or equal to 40 mA/cm^2 to the consumable anode.

44. The apparatus of claim 39, wherein the power source is adapted to provide a current density greater than or equal to 90 mA/cm^2 to the consumable anode.

45. An apparatus adapted to reduce the formation of sludge in an electroplating cell adapted to receive a substrate having an exposed surface area in contact with an electrolyte solution, the apparatus comprising:

a consumable anode adapted to have an exposed surface area in contact with the electrolyte solution, the exposed surface area of the consumable anode is less than the exposed surface area of the substrate.

46. The apparatus of claim 45, wherein the exposed surface area of the consumable anode is less than or equal to about one-half the exposed surface area of the substrate.

47. The apparatus of claim 45, wherein the exposed surface area of the consumable anode is less than or equal to about one-third the exposed surface area of the substrate.

48. The apparatus of claim 45, wherein the exposed surface area of the consumable anode is less than or equal to about one-fourth the exposed surface area of the substrate.

49. The apparatus of claim 45, wherein the exposed surface area of the consumable anode is greater than or equal to about 1/12 the exposed surface area of the substrate.

50. The apparatus of claim 45, wherein the exposed surface area of the consumable anode is greater than or equal to about 1/10 the exposed surface area of the substrate.

51. The apparatus of claim 45, wherein the consumable anode is at least partially surrounded by an impermeable membrane.

52. The apparatus of claim 45, wherein the consumable anode comprises copper.

53. The apparatus of claim 52, wherein the consumable anode further comprises tellurium.

54. The apparatus of claim 45, where the consumable anode comprises a plate.

55. The apparatus of claim 45, where the consumable anode comprises an array.

56. The apparatus of claim 45, wherein the consumable anode has holes formed therethrough.

57. The apparatus of claim 56, wherein the consumable anode comprises a perforated anode.

58. The apparatus of claim 56, wherein the consumable anode comprises a mesh.

59. The apparatus of claim 45, further comprising an insulator partially covering the consumable anode.

60. An apparatus adapted to reduce the formation of sludge in an electroplating cell adapted to receive a substrate having an exposed surface area in contact with an electrolyte solution, the apparatus comprising:

a consumable anode adapted to have an exposed surface area in contact with the electrolyte solution, wherein the exposed surface area of the consumable anode is less than the exposed surface area of the substrate and wherein the consumable anode has a diameter substantially equal to a diameter of the substrate.

61. The apparatus of claim 60, wherein the exposed surface area of the consumable anode is less than or equal to about one-half the exposed surface area of the substrate.

62. The apparatus of claim 60, wherein the exposed surface area of the consumable anode is less than or equal to about one-third the exposed surface area of the substrate.

63. The apparatus of claim 60, wherein the exposed surface area of the consumable anode is less than or equal to about one-fourth the exposed surface area of the substrate.

64. An apparatus adapted to reduce the formation of sludge in an electroplating cell adapted to receive a substrate having an exposed surface area in contact with an electrolyte solution, the apparatus comprising:

a consumable anode adapted to have an exposed surface area in contact with the electrolyte solution, the exposed surface area of the consumable anode is less than the exposed surface area of the substrate, the consumable anode having a diameter less than a diameter of the substrate.

65. The apparatus of claim 64, wherein the exposed surface area of the consumable anode is less than or equal to about one-half the exposed surface area of the substrate.

66. The apparatus of claim 64, wherein the exposed surface area of the consumable anode is less than or equal to about one-third the exposed surface area of the substrate.

67. The apparatus of claim 64, wherein the exposed surface area of the consumable anode is less than or equal to about one-fourth the exposed surface area of the substrate.

68. An apparatus adapted to reduce the formation of sludge in an electroplating cell adapted to receive a substrate having an exposed surface area in contact with an electrolyte solution, the apparatus comprising:

a consumable anode;

an insulator partially covering the consumable anode to limit an exposed surface area of the consumable anode in contact with the electrolyte solution to be less than the exposed surface area of the substrate.

69. The apparatus of claim 68, wherein the exposed surface area of the

consumable anode is less than or equal to about one-half the exposed surface area of the substrate.

70. The apparatus of claim 68, wherein the exposed surface area of the consumable anode is less than or equal to about one-third the exposed surface area of the substrate.

71. The apparatus of claim 68, wherein the exposed surface area of the consumable anode is less than or equal to about one-fourth the exposed surface area of the substrate.

72. The apparatus of claim 68, where the consumable anode comprises a plate.

73. The apparatus of claim 68, where the consumable anode comprises an array.

74. The apparatus of claim 68, wherein the consumable anode has holes formed therethrough.

75. The apparatus of claim 74, wherein the consumable anode comprises a perforated anode.

76. The apparatus of claim 74, wherein the insulator completely fills the holes of the consumable anode.

77. The apparatus of claim 74, wherein the insulator covers walls of the holes of the consumable anode permitting flow of fluid through the holes of the consumable anode.

78. An electroplating apparatus, comprising:

a reference electrode adapted to be disposed in a cavity of an electroplating cell proximate to a consumable anode disposed in the cavity of the electroplating cell.

79. The apparatus of claim 78, wherein the reference electrode is adapted to measure a potential of the consumable anode.

80. A consumable anode, comprising an alloy comprising copper and tellurium.

81. An electroplating apparatus, comprising:

an electroplating cell having a cavity;

a contact ring adapted to receive a substrate having an exposed surface area in contact with an electrolyte solution;

a consumable anode disposed in the cavity and adapted to having an exposed surface area in contact with the electrolyte solution, the exposed surface area of the consumable anode is less than or equal to about one-half the exposed surface area of the substrate; and

a power source coupled to the consumable anode and the contact ring; the power source adapted to provide a current density to the substrate between about 6 mA/cm^2 and about 60 mA/cm^2.

82. The electroplating apparatus of claim 81, wherein the consumable anode has a diameter substantially equal to a diameter of the substrate.

83. The electroplating apparatus of claim 81, wherein the consumable anode has a diameter less than a diameter of the substrate.

84. The electroplating apparatus of claim 81, further comprising an insulator partially cover the consumable anode to limit the exposed surface area of the consumable anode in contact with the electrolyte solution.

85. The electroplating apparatus of claim 81, further comprising a reference electrode disposed proximate the consumable anode.